UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MARYLAND

UNITED STATES OF AMERICA

v.

HOAU-YAN WANG,

Defendant.

CASE NO: TDC-24-211

GOVERNMENT'S RESPONSE IN OPPOSITION TO THE DEFENDANT'S MOTION TO EXCLUDE THE PROPOSED EXPERT TESTIMONY OF PAUL BROOKES, PH.D.

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The United States of America, by and through its undersigned counsel, hereby files its Response in Opposition to the Defendant's Motion to Exclude Expert Testimony of Paul Brookes, Ph.D. *See* ECF. No. 87. The government plans to call Dr. Paul Brookes at trial to testify as an expert about the Western blot protein detection technique and his analysis of Western blot images. Notwithstanding the Defendant's broad and unsupported proclamations to the contrary, Dr. Brookes possesses extensive and reliable expertise both in Western blots and in scientific image analysis, expertise that will certainly help the jury understand the evidence—he plainly qualifies as an expert under *Daubert* and its progeny and his testimony is admissible under Rule 702. *See id.* The Court should allow Dr. Brookes' testimony at trial and deny the Defendant's Motion.

I. BACKGROUND

On June 27, 2024, a grand jury sitting in the District of Maryland returned an indictment charging Defendant Hoau-Yan Wang with (1) one count of major fraud against the United States, in violation of 18 U.S.C. §§ 1031 and 2; (2) two counts of wire fraud, in violation of 18 U.S.C. §§ 1343 and 2; and (3) and one count of false statements, in violation of 18 U.S.C. §§ 1001 and 2. ECF No. 1 The Indictment alleges a scheme executed by the Defendant in which he fraudulently obtained grant funding from U.S. National Institutes of Health ("NIH") by making materially false representations relating to his Western blot scientific research in NIH grant applications and other documents. *See generally,* ECF No. 1. On August 21, 2025, the Defendant filed a motion to exclude the expert testimony of Dr. Brookes. ECF. No. 87. Trial is scheduled to begin on October 20, 2025. ECF No. 80.

Dr. Paul Brookes

The government plans to call Dr. Brookes to testify at trial about (1) what Western blots are, how they are conducted, and how to interpret the results; and (2) his examination of certain

Western blot images and other data submitted to NIH in grant applications and conclusions that those submissions to NIH were fabricated. Dr. Brookes' corresponding reports and analysis have all been provided to the Defendant in discovery, including approximately twenty reports and other analyses that pertain directly to the allegedly falsified NIH grant figures previously identified to the Defendant and the Court. *See* ECF. No. 68.

Dr. Brookes has an undergraduate degree in biochemistry from University College, London and a doctorate in biochemistry from the University of Cambridge. ECF No. 87, Ex. 2. He is a tenured Professor in the Department of Anesthesiology at the University of Rochester where he has worked for more than two decades; he has published more than 150 papers, given more than 70 lectures on various topics, including image analysis and research integrity, and has received applied for and received NIH grant funding for several decades. *Id.* Dr. Brookes has conducted, overseen, and reviewed thousands of Western blots experiments over the course of decades in his laboratories. Dr. Brookes continues to conduct a number of Western blot experiments himself and oversee others that take place in his laboratory. *See id.*

Dr. Brookes also has been doing scientific image analysis for over a decade in public forums and elsewhere and has been invited to speak and write on the subject. ECF No. 87, Exs. 2, 3. Dr. Brookes has also published two papers about research misconduct and image analysis. Brookes PS. Internet publicity of data problems in the bioscience literature correlates with enhanced corrective action. *PeerJ* 2: e313 (2014); Brookes PS. Misconduct Detection - Evolving Methods & Lessons from 15 Years of Scientific Image Sleuthing. *J. Law Med. Ethics* (2025). Developers have used Dr. Brookes' expertise to test software to detect image manipulation. ECF No. 87, Ex. 3. Dr. Brookes' efforts have resulted in hundreds of retractions and several adjudicated misconduct findings by the U.S. Department of Health and Humans Services' Office of Research

Integrity ("ORI"). *Id.*; *see* Findings of Research Misconduct: John Pastorino. Department of Health and Human Services. https://grants.nih.gov/grants/guide/notice-files/NOT-OD-14-010.html (last accessed September 3, 2025) (describing ORI's findings that the subject "engaged in research misconduct by intentionally falsifying and/or fabricating" Western blot data and images falsifying Western blot" data and figures" in a NIH grant application and other publications); Findings of Research Misconduct: Nitin Aggarwal. Department of Health and Human Services. https://grants.nih.gov/grants/guide/notice-files/NOT-OD-14-010.html (last accessed September 3, 2025) (describing ORI's findings the subject "engaged in research misconduct by falsifying Western blot" data and figures" in a NIH grant application and other publications). As a result of his image analysis expertise, various scientific journals send Dr. Brookes articles to review and analyze with images that appear suspicious for one reason or another. Dr. Brookes reviews dozens of manuscripts for scientific journals each year.

II.   LEGAL STANDARD

Under Rule 702 and *Daubert* courts admit expert testimony when: (1) the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue; (2) the testimony is based on sufficient facts or data; (3) the testimony is the product of reliable principles and methods; and (4) the expert has reliably applied the principles and methods to the facts of the case. Fed. R. Ev. 702; *see Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 595-98 (1993). *Daubert* "set forth a two-part test which must be met in order for such expert testimony to be properly admitted: (1) the expert testimony must consist of "scientific knowledge"-that is, the testimony must be supported by appropriate validation; and (2) the evidence or testimony must "assist the trier of fact to understand the evidence or to determine a fact in issue." *United States v. Dorsey*, 45 F.3d 809, 813 (4th Cir. 1995)

(citing *Daubert*, 509 U.S. at 591). "In determining whether certain expert evidence properly satisfies the first "scientific knowledge" prong of the two-part test, the [*Daubert* Court] held that trial courts may consider several factors: (1) whether the theory or technique used by the expert can be, and has been, tested; (2) whether the theory or technique has been subjected to peer review and publication; (3) the known or potential rate of error of the method used; and (4) the degree of the method's or conclusion's acceptance within the relevant scientific community." *Id.*

"Importantly, the inquiry to be undertaken by the district court is a flexible one focusing on the principles and methodology employed by the expert, not on the conclusions reached." *Jones v. Allen*, 2016 WL 9443772, at *2–3 (D. Md. 2016) (citing *Westberry v. Gislaved Gummi AB*, 178 F.3d 257, 261 (4th Cir.1999)) (quotations omitted). A witness' qualifications are "liberally judged by Rule 702," and "a person may qualify to render expert testimony in any one of the five ways listed" by the Rule: "knowledge, skill, experience, training, or education." *Kopf v. Skyrm*, 993 F.2d 374, 377 (4th Cir. 1993); *see also Cooper v. Lab'y Corp. of Am. Holdings, Inc.*, 150 F.3d 376, 380 (4th Cir. 1998).

III.   ARGUMENT

Dr. Brookes' Expert Western Blot Testimony is Admissible

Notwithstanding the framing of the Defendant's argument to exclude all of Dr. Brookes' testimony, he does not meaningfully contest that Dr. Brookes is an expert in Western blotting (nor can he). *See* ECF No. 87 at 1 ("Dr. Brookes testimony should be excluded."); *but see generally* ECF No. 87 (failing to challenge Dr. Brookes' expertise in Western blotting).[1] The core false

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[1] Although the Defendant misguidedly claims that Dr. Brookes is not a neuroscientist and does not have experience "performing drug research for a private company associated with his University," the government does not offer his testimony on either of those topics. *See* ECF No. 87 at 2, 11. Nevertheless, Dr. Brookes does have substantial neuroscience experience, doing his post-doctoral work at Institute of Neurology at University College London and publishing approximately ten papers related to neuroscience; he also has further experience as a Principal Investigator for multiple NIH grants over the decades, and doing research for private companies. ECF No. 87, Ex. 2.

representations alleged in the Indictment relate to Western blots. *See generally* ECF No. 1; *see also* ECF No. 68, Ex. A. Before jurors can assess the government's evidence of manipulation, they need to understand what a Western blot is, a scientific analytical technique beyond the ken of most jurors. They will need to broadly understand what a Western blot is and what its purpose is (to detect and identify proteins in experimental samples), how it works (a multi-step process involving gels, antibodies, and the transfer of the results into an image), and how to understand the results (both images and quantified densitometry data).[2] The jurors will also need to understand that Western blots are extensively and almost uniformly accepted as reliable in biochemistry when properly conducted. Using his decades of Western blot expertise (and experience teaching), Dr. Brookes will be able to explain all of this Western blot background to the jurors to help them to understand the basic evidence in the case. This testimony will include explaining how data spreadsheets underly certain Western blot densitometry charts and how the data in certain of the Defendant's spreadsheets associated with Western blot NIH application figures appear fabricated based on an examination of the information and calculations contained in the spreadsheets.

This type of testimony clearly qualifies under *Daubert*: (1) Western blots can be and have been extensively tested; (2) Western blotting has been subjected to extensive peer review and publication; (3) Western blotting has an understood potential rate of error and set of standards; and (4) Western blotting has achieved broad general acceptance in the relevant scientific communities. *See Dorsey,* 45 F.3d at 813. Dr. Brookes' expertise in the long-established and reliable Western blot technique, coupled with the clear relevance of such testimony to the charged false representations in this case establishes the admissibility of Dr. Brookes' expert Western blot

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[2] Densitometry is the quantitative measurement of optical density in light-sensitive materials, which in Western blot analysis is the measurement of density of the protein bands on the image.

testimony at trial, none of which the Defendant meaningfully contests in his Motion. *See* ECF No. 87.

Dr. Brookes' Expert Image Analysis Testimony is Admissible

a. Western Blot Image Analysis is an Established and Reliable Expertise

Image analysis is a long-established discipline for the purpose of uncovering errors, mistakes, and scientific misconduct in Western blots images. Accordingly, this is exactly the type of "scientific knowledge" that is "supported by appropriate validation" understood by *Daubert* to be admissible where, as in this case, that testimony will assist the jury in understanding the evidence and facts in issue. *See Daubert*, 509 U.S. at 591. The applicable methods, tools, and standards for image analysis and, in particular, Western blot image analysis, has been the subject of peer-reviewed scientific literature dating back a number of years. For example:

- Four authors discussed the image analysis technique of provenance analysis (detecting image manipulation by searching for and identifying ancestor images for manipulated offspring images) and proposed a system to overcome particular challenges relating to retrieving and finding the source images. Zhang, X., Sun, Z. H., Karaman, S. & Chang, S.-F. Discovering image manipulation history by pairwise relation and forensics tools. *IEEE J. Select. Top. Signal Process.* (2020).

- Three authors described a process of reviewing over 20,000 images from papers published in scientific journals and identifying problematic figures in 4% of the papers, half of which exhibited features of deliberate manipulation; to identify the problematic figures, the authors used visual inspection and colorization software. Bik EM, Casadevall A, Fang FC. The Prevalence of Inappropriate Image Duplication in Biomedical Research Publications. *mBio* (2016).

- Two authors discussed different types of image manipulation, the standards for manipulation, and ways to detect manipulation, including by contrast adjustment of the images and high-resolution analysis of the images. Rossner, M. & Yamada, K. What's in a picture? The temptation of image manipulation. *J. Cell Biol.* 166 (2004).

Some of the peer-reviewed articles also proposed and utilized software and automation to detect image manipulation. Chaturvedi AP, Hibbard A, Nelson C, Casadevall A, Kullas AL. ASM incorporates Imagetwin to address image duplication and preserve scientific accuracy. *mBio.*

(2025) (discussing the use of the software program ImageTwin to identify image duplications in papers, including Western blot images); Drishty Chaudhary. Testing the Working Efficiency of Open-Source Tools IrfanView and FotoForensics against Deep-Fakes Detections in Images. *International Journal of Medical Toxicology and Legal Medicine* 27(1) (2024) (discussing the use of FotoForensics error analysis software, along with metadata analysis, histograms, and edge detection to identify manipulated and fake images); Bucci, E. Automatic detection of image manipulations in the biomedical literature. *Nat. Cell Death Dis.* 9 (2018) (discussing software developed to identify image manipulation, including for Western blot images). Other articles discussed the use of artificial intelligence to detect image manipulation. Moreira, D., Cardenuto, J.P., Shao, R. *et al.* SILA: a system for scientific image analysis. *Sci Rep* 12, 18306 (2022) (proposing an artificial intelligence system with human input that performs image manipulation detection on Western blot and other figures using provenance analysis, among other features);[3] Mandelli, S. et al. Forensic analysis of synthetically generated western blot images. *IEEE Access* 10 (2022) (discusses the detection of synthetically generated Western blot images using an artificial detector). In order to program and use these computer-based systems, the designers necessarily use standardized, replicable techniques to detect image manipulation, which is in itself evidence of the reliability of this type of expertise; if there were no standardized methods, machines could not be trained to detect image manipulation. In sum, the peer-reviewed scientific literature indicates that Western blot image analysis can be tested, has been tested, and that methods and standards are sufficiently replicable that they can be automated through software and through machine learning.

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[3] Dr. Brookes contributed data to the authors of this paper but was not himself an author.

The methods and standards of the image analysis discipline are sufficiently rigorous that the U.S. Department of Health and Human Services ("HHS") has relied on them for many years to investigate and adjudicate scientific misconduct. More specifically, ORI investigates and makes findings about scientific misconduct using the same tools Dr. Brookes employed in his review of the Defendant's Western blots for testimony in this case. And in instances where the subject of the investigation disputes ORI's findings, and any derivative debarment decisions, those subjects may appeal adverse decisions to an Administrative Law Judge within HHS and ultimately, if they choose, to a U.S. District Court. *See, e.g., Brodie v. HHS*, 796 F. Supp. 2d 145 (D.D.C. 2011) (upholding ORI's findings that a biologist engaged in "falsification" and "fabrication" in support of HHS's seven-year debarment from receiving federal funds). A number of these image analysis tools and methods are made publicly available by HHS (since 2005) so that universities and other grant sponsors (as well as other members of the public) may use them in instances where they conduct their own scientific misconduct investigations for their own purposes and at their own initiative, or at the direction of ORI in connection with allegations of misconduct relating to NIH or other HHS-funded grants. For example:

- ImageJ (NIH hosted) – ImageJ can display, edit, and analyze all manner of color and grayscale image files, including by providing area and pixel value statistics, density histograms, contrast manipulation, sharpening, smoothing, edge detection, and geometric transformation features, among others. ImageJ – Image Processing and Analysis in Java. https://imagej.net/ij/ (last accessed September 2, 2025).

- Advanced Forensic Image Tools (ORI hosted) – These software add-ons to Photoshop are meant to identify "visualizations of intrinsic irregularities within images" and compare images through the use of advanced gradient map, adjustment layers, overlays, and smart edge features, among others. Advanced Forensic Actions. Office of Research Integrity, Advanced Forensic Actions | ORI - The Office of Research Integrity (last accessed September 2, 2025).

ORI's misconduct findings are publicly available on ORI's website as long as they are active and in perpetuity where they are also published in the Federal Register. *See generally* Case

Summaries. Office of Research Integrity, [Case Summaries | ORI - The Office of Research Integrity](#) (last accessed September 3, 2025). A review of ORI's findings of misconduct reveals that Western blot image fabrication and falsification is one of the most common bases for misconduct findings—ORI regularly conducts image analysis in its investigations and makes findings of misconduct using the same basic tools, techniques, and methods that Dr. Brookes has employed in his review of the Defendant's images.[4] *See id.* This type of image analysis is sufficiently rigorous for HHS to regularly make public findings of misconduct, including those Dr. Brookes contributed to, as identified above, and to adjudicate those findings where necessary. It is also sufficiently rigorous for universities, companies, and other grant sponsors to do their own investigations and make their own findings. All of this usage of the type of image analysis employed by Dr. Brookes indicates both broad "acceptance" within the "relevant scientific community," as well as the "existence and maintenance of standards" for image analysis and that the technique has been "tested" (and used repeatedly). *See Daubert*, 509 U.S. at 593-94.

To make a contrary argument, the Defendant displays ignorance of both the literature discussing Western blot image analysis and ORI's regular usage of image analysis in its investigations and adjudications discussed above, and relies primarily on the entirely distinguishable scenario addressed in *Dorsey*, 45 F.3d at 811-15. *See* ECF No. 87 at 7-9. In

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[4] *See, e.g.*, Case Summary: Zhang, Liping. Office of Research Integrity, [Case Summary: Zhang, Liping | ORI - The Office of Research Integrity](#) (also available at https://www.federalregister.gov/documents/2025/03/19/2025-04489/findings-of-research-misconduct) (last accessed September 3, 2025) (describing ORI's findings on a preponderance standard that the subject "knowingly falsified and fabricated" Western blot images in NIH grants); Case Summary: Eckert, Richard L. Office of Research Integrity, [Case Summary: Eckert, Richard L | ORI - The Office of Research Integrity](#) (also available at https://www.federalregister.gov/documents/2024/08/15/2024-18289/findings-of-research-misconduct) (last accessed September 3, 2025) (describing ORI's findings that the subject "intentionally, knowingly, or recklessly falsified and/or fabricated Western blot" images in NIH grants); and Case Summary: Danenberg, Andrew. Office of Research Integrity, [Case Summary: Dannenberg, Andrew J. | ORI - The Office of Research Integrity](#) (also available at https://www.federalregister.gov/documents/2023/09/13/2023-19779/findings-of-research-misconduct) (last accessed September 3, 2025) (describing ORI's findings that the subject "recklessly reported falsified and/or fabricated Western blot image data" in NIH grants).

Dorsey, the defense provided late notice (on the first day of trial) of testimony by "forensic anthropologists" to compare bank surveillance photos against recent photographs of the defendant to advance a defense of mistaken identity in a robbery. 45 F.3d at 812. The court found that there was no evidence that the basis for the proffered testimony had been tested, subjected to peer review, accounted for a high error rate, or was widely accepted in the scientific community under *Daubert* and was excludable. *Id.* at 814-15. The court also found that the comparison of photographs of people was within the common knowledge of the juror and did not need expert testimony. *Id.* at 815. In contrast, as described above and below, every one of these factors cuts in favor of the admission of Dr. Brookes' image analysis testimony rather than against it—proper notice was given of Dr. Brookes' extensive and standardized image analysis, a practice that has been tested and used for decades (as evidenced by the ORI methods and findings that are published on their website and the findings published in the Federal Register), subjected to peer review (as evidenced by the literature summarized above), with articulated methods accounting for errors, and is generally accepted in the scientific community. Also, the jury in the instant matter, unlike that of *Dorsey*, likely has no experience in or knowledge about Western Blot images—a commonly used tool in medical and biological research, but virtually unknown to the public at large—whereas every juror has experience evaluating an image of a person. Western Blot images are the results of scientific experiments, and concern the exact type of scientific, technical, and specialized knowledge for which an expert is needed to explain and assist the trier of fact to understand the evidence presented at trial. *See* Fed. R. Evid. 702(a). *Dorsey* is inapposite and, if anything, the distinguishing factors support the admission of Dr. Brookes' testimony rather than undermine it. *See Dorsey*, 45 F.3d at 811-815.

Finally, recognizing ORI's specific expertise in the Western blot image analysis arena, the government shared Dr. Brookes' analytical reports of the Defendant's Western blot images with ORI and ORI validated Dr. Brookes' approach and the reports that form the basis of his expected image analysis testimony at trial.[5] This validation is unsurprising given Dr. Brookes' expertise in this area and indicates very specifically that there is a substantial degree of acceptance of his testimony "within the relevant scientific community." *See Daubert*, 509 U.S. at 594.

b. Dr. Brookes is a Western Blot Image Analysis Expert

Dr. Brookes' Western blot image analysis expertise is more than sufficient to clear the "liberally judged" standard for qualification under Rule 702. *See Kopf*, 993 F.2d at 377. Indeed, Dr. Brookes could easily qualify as an expert under several of the independent bases established under the Rule (knowledge, skill, experience, training, or education). *See id.*

Dr. Brookes has exhibited his knowledge of Western blot image analysis in a number of ways: as a foundation, his extensive work doing, overseeing, and reviewing thousands of Western blots forms a comprehensive understanding of Western blot images; he has published works on this specific topic of image analysis; he has long participated in public debates and forums on image analysis (both his own, and others); and he has a deep understanding of the image analysis techniques, tools, and how to use them, which is exhibited in the substance of his reports on the Defendant's images discussed in greater detail below. Dr. Brookes also has substantial skill using the various image analysis tools and techniques (also used by ORI) that are detailed in his reports, including but not limited to ImageJ, high-resolution magnified comparisons, PowerPoint and Adobe Photoshop filters and adjustments, curves, recoloring, histogram analysis, and

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[5] ORI described Dr. Brookes' analyses as "good" and made approximately a dozen suggestions across his reports, most of which he went back and implemented into what became his final reports.

densitometry. *See* ECF No. 87, Ex. 4 (Report 2). In addition, Dr. Brookes has extensive experience in Western blot image analysis, including that which forms the basis of his knowledge, but also to include his work identifying specific misconduct of certain individuals which has resulted in hundreds of paper retractions and several misconduct findings by ORI. *See* ECF No. 87, Ex. 3.

Dr. Brookes' image analysis work is not separate from his broader scientific expertise or otherwise peripheral to it—it is derivative of that expertise and is a specialization on which he has published formally and informally, been invited to speak at scientific conferences, and the reason he has been asked to review suspicious images by peer-reviewed scientific journals. All of Dr. Brookes' image analysis expertise more than meets the requirements for expert testimony under Rule 702 and the accompanying law and, coupled with his long experience teaching, positions him well to make complicated scientific techniques accessible to jurors. *See Kopf*, 993 F.2d at 377.

c. Dr. Brookes Expected Testimony is Reliable

Dr. Brookes' analytical work on the Defendant's Western blot images memorialized in his reports is simply the application of techniques and methods previously invented and used by others, not Dr. Brookes. Much of the Defendant's efforts to exclude Dr. Brookes' testimony seem to center on the idea that Dr. Brookes' analyses were created out of "whole cloth." *See* ECF No. 87 at 7. And if Dr. Brookes were the first to use the methods and techniques and to make findings about Western blot images perhaps that argument would have more salience, but, notwithstanding Dr. Brookes' facility with these techniques, he did not invent any of them (or any of the associated tools)—they have been used to identify image fabrication and manipulation long before Dr. Brookes ever looked at one of the Defendant's Western blot images. These are the same methods and techniques Dr. Brookes has long used to review images and manuscripts at the request of scientific journals and on which he been asked to speak and write in professional scientific forums.

The eight different analytical methods and tools Dr. Brookes identified at the outset of his work are not his invention but instead are functions already discussed, tested, and used in the peer-reviewed literature and the NIH/ORI methods and tools described above. *See* ECF No. 87, Ex. 4 (Report 2). For example, Rossner discusses the use of high-resolution magnification and contrast adjustment, Drishty discusses the use of histograms (and FotoForensics software), and Chaturvedi discusses the use of ImageTwin software to identify duplicate images, all of which are among Dr. Brookes' eight methods. *See* Chaturvedi *et al.* ASM incorporates Imagetwin to address image duplication and preserve scientific accuracy. *mBio.*(2025); Drishty Chaudhary. Testing the Working Efficiency of Open-Source Tools IrfanView and FotoForensics against Deep-Fakes Detections in Images. *International Journal of Medical Toxicology and Legal Medicine* 27(1) (2024); Rossner. What's in a picture? The temptation of image manipulation. *J. Cell Biol.* 166 (2004). Contrary to the Defendant's claim that the proper inquiry about peer review is whether the peer review of Dr. Brookes two image analysis published papers was sufficient, the question instead is whether there is a body of peer-reviewed articles that validate the methods he employs (and some of which he has cited in his own papers). *See* ECF No. 87 at 15. And the answer to that question, based on record of peer-reviewed articles described above and otherwise available, is yes.

The Defendant also claims that Dr. Brookes' statement on his laboratory blog that he estimates he rejects 50% of the manuscripts he reviews because they involve manipulated data or other signs of misconduct somehow indicates that his analysis is erroneous "because it would find fully half of all scientific manuscripts are fraudulent." ECF No. 87 at 16. This argument is inapposite because Dr. Brookes' statement here is not a statement about the error rate of image analysis methodology. *See Daubert*, 509 U.S. at 594. Furthermore, it ignores the context, which is

made clear in the next paragraph in which Dr. Brookes expresses a willingness "to take a look at anything suspicious that anyone sends me." Paul S. Brookes, *PSBLAB: Cardiac Mitochondrial Research in the Lab of Paul S. Brookes, PhD – Science Fraud*, PSBLAB, https://psblab.org/?page_id=778 (last visited September 2, 2025). The manuscripts Dr. Brookes receives for review are not a representative cross section of scientific manuscripts but instead are often manuscripts that already exhibit suspicious indications of potential manipulation and are brought to Dr. Brookes precisely because of his image analysis expertise. In other words, these manuscripts had already been identified as potentially problematic and, therefore, it is not surprising that a substantial percentage of them would contain signs of potential misconduct. Moreover, the fact that scientific journals seek out Dr. Brookes' review of potentially manipulated images because of his expertise in image analysis is itself a strong indication of his expertise in image analysis and qualifications to testify as an expert under Rule 702.

Dr. Brookes' analytical approach using provenance analysis and other methods and standards described above, involves reverse analysis of the images (to recreate the Defendant's original image from his final NIH image), forward analysis of the image (to recreate the Defendant's final NIH image from his original image), and additional analysis using methods identified above and certain other techniques, such as terminal digit analysis, is reliable, as confirmed by ORI (which uses many of the same methods, principles, and tools that Dr. Brookes employs). Indeed, Dr. Brookes' demonstrated knowledge and facility with these methods only further shows his image analysis skill, bolstering his qualifications under Rule 702.

Dr. Brookes' expert testimony for trial in this matter meets each of the requirements under *Daubert* and Rule 702: (1) the image analysis methods used by Dr. Brookes can and have been tested, including in ORI investigations, findings, and adjudications; (2) the methods and tools have
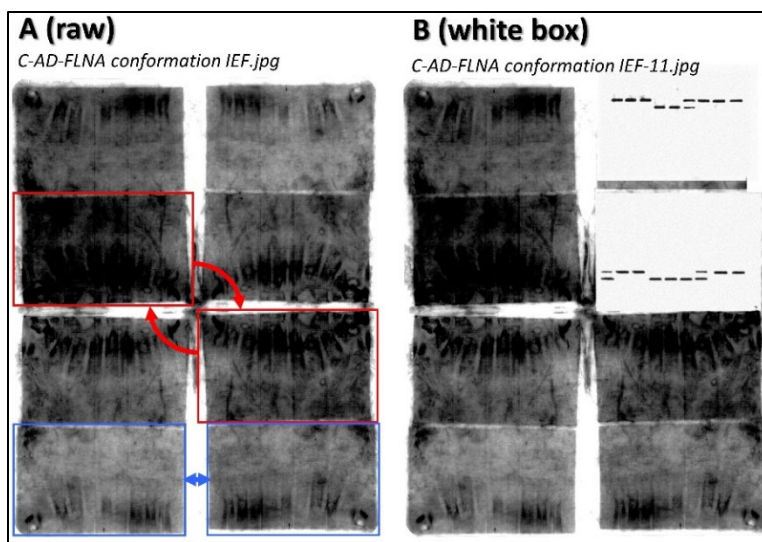
been subjected to peer review and publication as described above; (3) those methods and standards account for potential error rates; and (4) the methods used by Dr. Brookes are accepted by the relevant scientific community—in peer-reviewed publications, by ORI, and in Dr. Brookes' own work. *See Dorsey*, 45 F.3d at 813. And Dr. Brookes particular expertise in this type of image analysis is more than sufficient to meet the standards of Rule 702 based on his knowledge, skill, and experience, further demonstrated by his application of accepted methods and principles in his analyses. *See Jones*, 2016 WL 9443772, at *2–3; *see, e.g.*, Ex. 1.

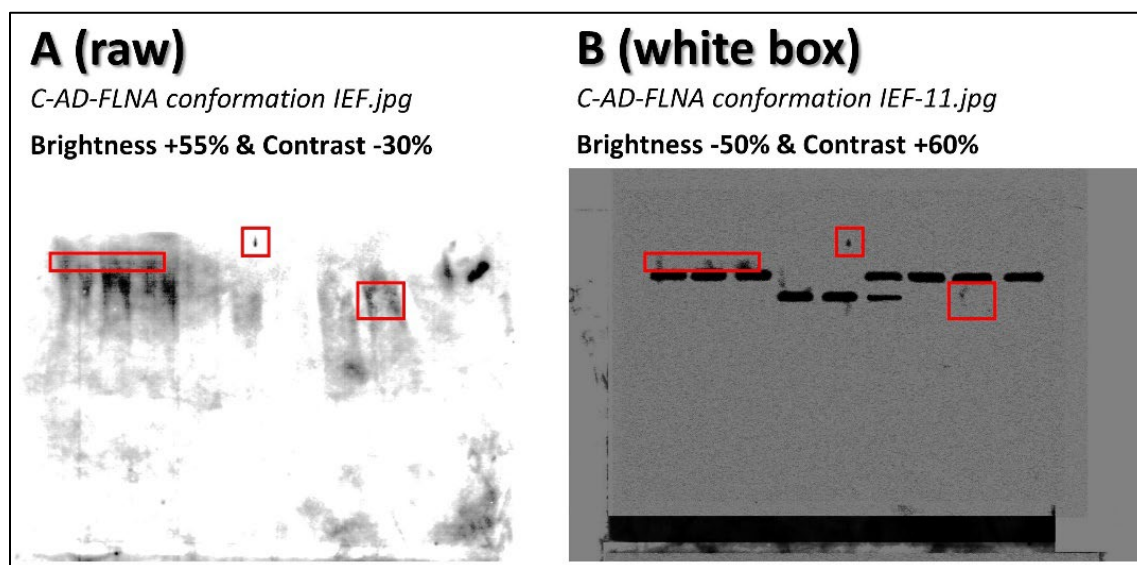### d. Dr. Brookes' Analysis of Figure 1 (Report 4.7)

Dr. Brookes has produced several dozen reports analyzing the Defendant's images and other data using the process, principles, and methods identified and described above, including roughly twenty reports and analyses of the specific figures contained within the grant applications identified in the Indictment's charged conduct (and identified to the Court and the Defendant). *See* ECF No. 1; ECF No. 68. By way of example, in one report that maps his expected testimony Dr. Brookes laid out his reasoning for why Figure 1 depicted in the Indictment and submitted in connection with four of the five charged grants (that was also published in one of the journal articles identified in the Indictment) was fabricated. Ex. 1.

After introducing and providing background information about the figure, Dr. Brookes explained his conclusions from his reverse analysis, which attempts to trace bands in the final image that ends up in the NIH grant application from those in the original or raw image (recovered from Dr. Wang's residence).[6] *Id.* In short, he concluded that the bands in the upper rightmost of the eight blots in the "white box" image ended up in the figure in the NIH application but those bands could not be found in the original "raw" image:

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[6] The images Dr. Brookes analyzed for his reports were provided to him by the FBI in small batches and a large drive containing a large portfolio of images.

A (raw)
C-AD-FLNA conformation IEF.jpg
B (white box)
C-AD-FLNA conformation IEF-11.jpg

Id. He further concluded that the common background features indicate that both images came from the same source image by using one of the publicly available ORI Photoshop gradient mapping tools identified above. *Id.* Dr. Brookes also conducted a forward analysis in which he tried to recreate the bands in the "white box" image by magnifying and adjusting the brightness and contrast of the corresponding blot in the "raw" image, but found it impossible to do so:

A (raw)
C-AD-FLNA conformation IEF.jpg
Brightness +55% & Contrast -30%
B (white box)
C-AD-FLNA conformation IEF-11.jpg
Brightness -50% & Contrast +60%

Id. He concluded that the bands in the "white box" image could not be found in the "raw" image (but also that background features in the red boxes matched, confirmed also by color gradient

mapping). *Id.* Put differently, the "raw" image on the left is what should have been submitted to NIH for this experiment (and does not contain useable band data), not the image on the right with the superimposed "white box" and bands. Dr. Brookes also found that the Y-axis labels for this figure in the submitted version do not make sense, the description of the method used is not acceptable for the purpose of the experiment, the "raw" image data is of such poor quality it would be discarded as unusable in most labs, and that the densitometry chart associated with Figure 1 has multiple anomalies indicative of fabrication. *Id.* Taking all of this analysis together, Dr. Brookes concluded that the image depicted in Figure 1 was fabricated. *Id.*

Each of Dr. Brookes' reports follow a similar analytical process, although certain supplementary techniques and analyses were applicable for some of the images but not others. Other than broad claims and assertions that Dr. Brookes methods are unreliable, the Defendant does not attack any of his analytical steps or find fault with the logic of the conclusions he reaches from those steps. *See generally* ECF No. 87. That is because Dr. Brookes' analysis is reliable, just as ORI's image analysis is reliable, all supported by methods discussed and examined in peer-reviewed literature described above.

Dr. Brookes' Expected Testimony Will Properly Assist the Jury in Understanding the Evidence and Determining Facts in Issue

Lastly, the Defendant claims that Dr. Brookes' testimony would not assist the jury for purposes of *Daubert* and would usurp the jury's role. ECF 87 at 14. For most jurors, who will never have heard of a Western blot before much less seen a Western blot image, Dr. Brookes testimony will unquestionably be helpful to their understanding of Western blots and Western blot images. However, the Defendant claims, analogizing to the photographs of people in *Dorsey*, "jurors can use their own common sense and observational skills" to compare images. ECF No. 87 (citing *Dorsey*, 45 F.3d at 814). Even setting aside the self-evident distinction between

photographs of people and highly-technical image results of scientific experiments, the Defendant's broader arguments are logically inconsistent—it cannot both be the case that image analysis comparison is so untethered to testing, methods, and standards that is unreliable to be presented at trial and it is also so easy that any juror can do it based on their "own common sense and observational skills." Properly understood, Dr. Brookes' expert testimony will help the jurors proceed from the beginning of trial, when they will have no understanding of what a Western blot is, to having a sufficient understanding of Western blots and Western blot images after Dr. Brookes testimony to assess the evidence for themselves, which is a quintessential fit for the purpose and requirements of Rule 702 and *Daubert*.

To the extent Dr. Brookes' expertise on Western blot image analysis can explain to the jury what is logically possible and what is not in connection with this type of experiment and why, therefore, certain images were fabricated will certainly assist the jurors in understanding the evidence in the case, it will not usurp their role. *See Daubert*, 509 U.S. at 591. And, indeed, the Defendant can point to no authority supporting this contention. *See* ECF No. 87 at 15. If, as the Defendant asserts, Dr. Brookes were to testify that "Dr. Wang manipulate[d] the Western blot research he was performing," that might be a closer question but his testimony will be limited to the images he reviewed and the conclusions that certain images were fabricated based on his review of the image record. The government will have to prove each of the elements of the charged crimes, including the existence of a scheme, attribution, and intent, among others. By way of analogy, it is not that different from a narcotics trial where a government expert testifies that the substance recovered was narcotics—that expert narcotics testimony does not end the case, excuse the government from proving the elements of the crimes charged (including attribution and intent), or usurp the jury's role; in this case, Dr. Brookes will testify that in his opinion based on his

analysis, the only explanation for the image manipulation was fabrication (subject to cross examination), but then the government will have to prove all of the elements of the charged crimes and the jury will have to fulfill its role in finding the facts and applying the law to reach a verdict, as they have done since time immemorial.

IV.   CONCLUSION

For the foregoing reasons, the Defendant's motion to exclude the expert testimony of Paul Brookes, Ph.D. should be denied.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a copy of the foregoing was filed with the Clerk of the Court

using the CM/ECF system, which will send notice to all counsel of record.

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/s/ Andrew Tyler
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